2004 Command and Control Research and Technology Symposium
'The Power of Information Age Concepts and Technologies'

FUTURE FORCE DEVELOPMENT CONCEPTS

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ABSTRACT

In 2002, the UK Ministry of Defence (MoD) tasked the Defence Science and Technology Laboratory to create a programme of work to analyse the impact of emerging alternative concepts and technologies.

The programme is called Joint Force Structures Development (JFSD). Its purpose is to inform UK policy, equipment and force managers of important implications that might affect their area of responsibility by showing where new concepts have the potential to influence force structures.

JFSD studies many varied themes including, amongst others, network enabled force structures, networked fires and dispersed operations, swarming, effects based operations, future command and control, coalition interoperability, space and alternative logistic concepts. In all cases, the UK joint force is examined and the implications for its size and composition identified.

The analysis process developed by JFSD is founded on the idea that a set of descriptive rules and planning guides can be developed that capture the essence of each concept, the principles that reflect its unique characteristics. A library of rule bases is produced and, set in the context of planning scenarios, development of alternative campaign plans that employ the concepts can be carried out. These can then be used in the development of future force structures.

INTRODUCTION

BACKGROUND

Modern force structures are complex: it can take many years to develop technologies and put them into service, to build up the knowledge, skills and experience required to undertake successfully operations across the broad spectrum of military tasks. But increasingly they must also be highly agile forces, able to deal with the uncertainties of the future, and robust to the kaleidoscope of threats that might arise. Though a force structure may take decades to evolve to a peak, the threats that it may face can appear overnight.

This then is the challenge facing the UK today – where do the threats lie in the future, and what forces do we require to meet them? What force characteristics are required: how do we equip them, train them, maintain them, prepare them and fight them?

FORCE DEVELOPMENT CONCEPTS

Currently, a lot of thought is going into developing new and radical ways of conducting military operations, of exploiting new technologies and seeking to secure a step change advantage through novel interpretations of warfare methods – many of which focus on the enhanced networking of forces. The implications for the shape of our future force structures, their size and composition, tactics and strategies, equipment and expertise need to be understood now.

For example, how exactly does a network-enabled force structure differ from one that isn't? What type and level of network capability is necessary, or just useful? How can we trade off force size and capability?

What level of re-structuring might result? In practice, force structures cannot be changed easily or rapidly. What might seem minor changes from a high level view in reality create great levels of upheaval when the more prosaic aspects of force development come into play.

We also need to understand the risks associated with force development - technical, military and political. In maintaining ready and effective forces, a culture of constant change cannot be good thing, and the process of changing the force composition may itself incur costs and risks.

There are numerous such novel approaches or technologies being proposed that could be explored, though many are immature - they are often too abstract, not fully understood or not yet technically achievable. Some of these concepts do, however, have more substance and, importantly, have the potential to impact on the size, shape and composition of the force structure.

WHAT IS A CONCEPT?

A concept is defined, literally, as a generalised idea or notion. For this work though, a force development concept is defined as an identifiable and distinct approach to

conducting military operations, usually facilitated by exploitation of new technologies.

The United Kingdom Ministry of Defence (MoD) thus initiated a high level Operational Analysis (OA) process to start answering the many questions that arose, a process that would need to learn and develop as it progressed. A process that would need to filter out those concepts that lacked enough substance to impact on the development of forces for the medium term. The Defence Science and Technology Laboratory (Dstl) was tasked to create this process in the autumn of 2002 which was to become known as Joint Force Structures Development.

JOINT FORCE STRUCTURES DEVELOPMENT

The Joint Force Structures Development study programme was created with a straightforward objective in mind:

To illustrate the implications for future force structure development of as wide a range of new concepts as possible – to look beyond the near future and try and envisage how the most radical, most novel force development concepts may influence the force structures the UK needs in the future.

Joint Force Structures Development has a wide remit then, tasked to study various themes, such as force readiness, force projection, urban and counter-terrorism operations, always seeking indications or trends that might affect the force structure or its management.

Within this role, Joint Force Structures Development is considered to fit into the high level experimentation process where this is defined as:

'Procedures undertaken to make a discovery, test a hypothesis, or determine a known fact – whose results and experiences from application are used to inform and base force development, concepts, training, acquisition, procurement and policy decisions'.

FORCE DEVELOPMENT AND FORCE PLANNING ANALYSIS

FORCE PLANNING ANALYSIS PROCESS

The Joint Force Structures Development work draws from a number of mature and established Force Planning Analysis processes developed over a number of years by Dstl. This process, which reports annually as part of the MoD planning cycle, tests current and planned force structures' ability to meet policy. Its outputs are used to support MoD decisions on force development (the size and composition of the force), equipment acquisition (the numbers and types) and force management (which includes a number of related issues such as personnel, training and equipment management). Force development is essentially the UK term for force transformation.

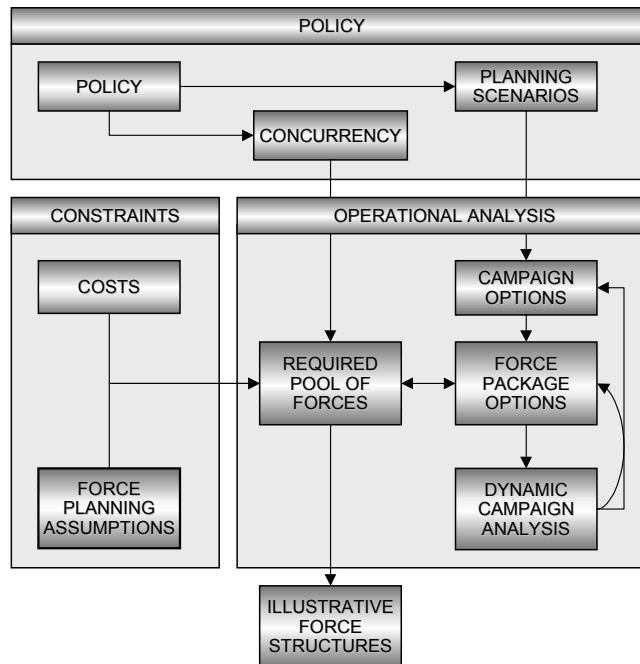Figure 1 illustrates the key stages in this work:

Figure 1: MoD Force Planning Analysis process

Policy

Policy is formulated and published by MoD setting out policy targets required to be met and it is against this set of requirements that all concepts are tested. A set of planning scenarios is maintained that covers the full spectrum of operations – by scale, type, environment, threat and so on. For example, one scenario may require a UK deployment in the restoration of a nation's national boundaries as part of a multi-national coalition, another may be a humanitarian operation or involve an ongoing peace keeping role. Planning scenarios are formulated by MoD to allow testing of force structures in an appropriate context that reflects Policy and are used for analysis and experimentation only.

Constraints

Constraints are represented in the analysis and fall into two broad categories: cost and force planning assumptions. Cost data is generated within Dstl by a dedicated cost analysis team. The costs used, called Equivalent Annual Costs, are produced for each force element included in the analysis, be it a section of combat engineers, a transport aircraft or a major warship. In simple terms, these are the cost of maintaining that force element in the force structure annually for its lifetime – this allows comparison of elements with differing in-service periods for example.

Force planning assumptions are broad in nature and may be thought of as force management policy – an example would be at what level of concurrent operations could we expect one individual service to be represented, or what sort of tour intervals should service personnel expect.

Operational Analysis

For each planning scenario, joint campaign plans are worked up with military and scientific staff and these are then used as a basis for the Force Estimation process. This involves a wide cross-section of military staff who decide on an appropriate force package – the military force elements to be deployed – for the campaign in order to meet its aims. Each campaign in turn is assessed, using comprehensive dynamic campaign modelling and analysis, testing the force structures' ability to:

- Generate the required force packages with sufficient levels of training and equipment within the required time scales;

- Deploy it into theatre within the time scales required;

- Provide sufficient operational effectiveness to achieve the stated campaign aims;

- Sustain the force throughout its deployment.

Policy includes requirements on the ability to meet the demand generated by concurrent deployments - when they occur simultaneously - of different types and scale. The force structure is tested against these requirements. A concurrency model has been developed for this very purpose.

This spreadsheet-based model represents the entire deployable force structure as a pool of force elements. Elements are typically platforms for air and maritime domains, such as a fast jet, transport aircraft or attack submarine. Equally, it could be trained aircrews as this may be the driving factor for some aircraft types. For the land domain, force elements are usually sub-formation level; a battery of artillery, a section of assault engineers or a brigade headquarters for example.

The availability of each element type is represented, as are potential alternatives. These substitutes are identified using military judgement and are capability based - ground attack aircraft may be deployed if there are insufficient numbers of artillery batteries. Similarly, if there are insufficient numbers of air defence aircraft then an air defence capable warship may be used where the scenario is littoral, anti-aircraft artillery may be needed where the scenario is not.

Substitution is an important part of the analysis as it can be used as a measure of the force structures effectiveness in meeting the demands placed upon it. Appropriate levels of substitution can mean a smaller force has the ability to meet a wider range of different scenario demands. Conversely, excessive substitution would indicate the force composition (or its management) is not well matched to the demands placed on it.

Where there are shortfalls or affluence of force elements, the model is able to establish, by trading force elements, a more effective force structure. It does this by determining which elements cause shortfall the most frequently and therefore effect the forces' ability to meet policy most. It then determines an appropriate pattern of

investments that will reduce the shortfall, though it produces illustrative force structure options only - they are not necessarily definitive. Constraints, such as maintaining constant cost, are applied during this process.

JOINT FORCE STRUCTURES DEVELOPMENT

SCOPE

Joint Force Structures Development complements the mainstream work of the Force Planning Analysis Programme - but where that is constrained, Joint Force Structures Development is not. The 'Helix of Force Development' shown in Figure 2 illustrates the point.
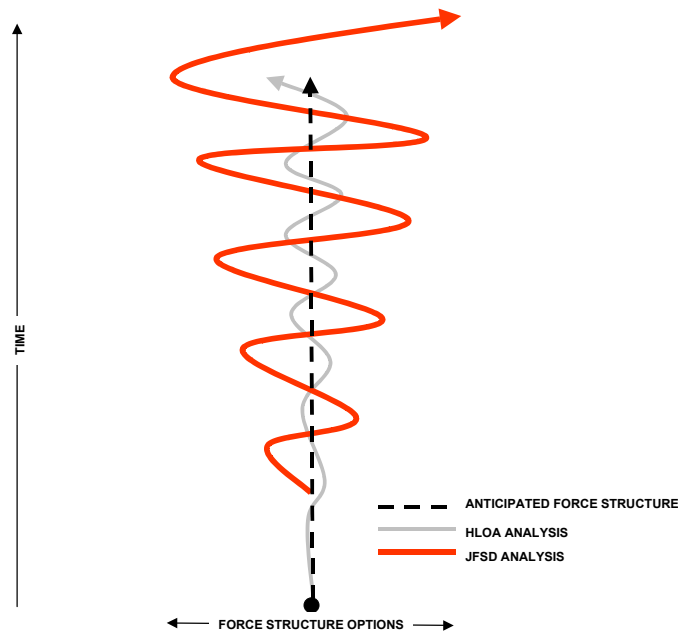

Figure 2: Helix of Force Development (Transformation)

Constrained by anticipated doctrine, tactics and equipment, the Force Planning Analysis work moves out from current and anticipated force structures – Joint Force Structures Development, in exploring novel approaches or technologies and moving further out into the future, is able to explore the extremes, seeking a radically different force structure that may yield a step change in effectiveness.

INITIAL WORK

The entire Joint Force Structures Development approach is founded on the idea that a rule base (*q.v.*) can be developed that encapsulates the essence of any concept, the principles that reflect its unique characteristics and how, if used in the context of a campaign plan, it would result in something different.

The original Joint Force Structures Development work had drawn extensively from the Force Planning Analysis process as shown in Figure 1. A rule base was developed for each of the various concepts to be tested - networked-based concepts for littoral air defence and networked precision land attack systems were examined, as was the

principle of swarming for improving low-cost Intelligence Surveillance Target Acquisition and Reconnaissance (ISTAR) product. The rule bases were used to modify the scenario force package produced for the main Force Planning Analysis[1]. These modified force structures were then tested against policy and the results analysed.

Initial study results, however, indicated that very little impact was made on the force structure by these new concepts. The conclusion was that:

The extensive interleaving of roles and capabilities of extant force elements means that individual concepts do not offer much potential in terms of changing force structure unless they allow elements to be replaced at reduced cost or allow a reduction in element numbers.

This then leads us to the supposition that:

Unless the force structure and its elements are redesigned from first principles, the potential of new force development concepts may not be fully realised.

This meant that more profound ways in which the concepts were exploited needed to be explored – and that Joint Force Structures Development needed to adopt a more thorough analytical approach.

To achieve this, the Joint Force Structures Development process is to undergo major change, broadening its scope and depth simultaneously. The process proposed, now under development, would consist of four key elements:

- **Scenario development**. Defining of the most basic elements of the scenarios that reflect the future world environment - and UK defence policy;

- **Rule base development**. Development of rule bases that encapsulate the concepts of most potential;

- **Campaign development**. Development of alternative campaign plans that employ the cutting edge thinking on operational approaches and technologies, defined in the rule bases;

- **Force Structures Analysis**. Development, testing and refinement of alternative force structures, consistent with force planning data and assumptions, that re-aligns Joint Force Structures Development to the main Force Planning Analysis product and allows it to support UK MoD decision making.

This process is shown in Figure 3.

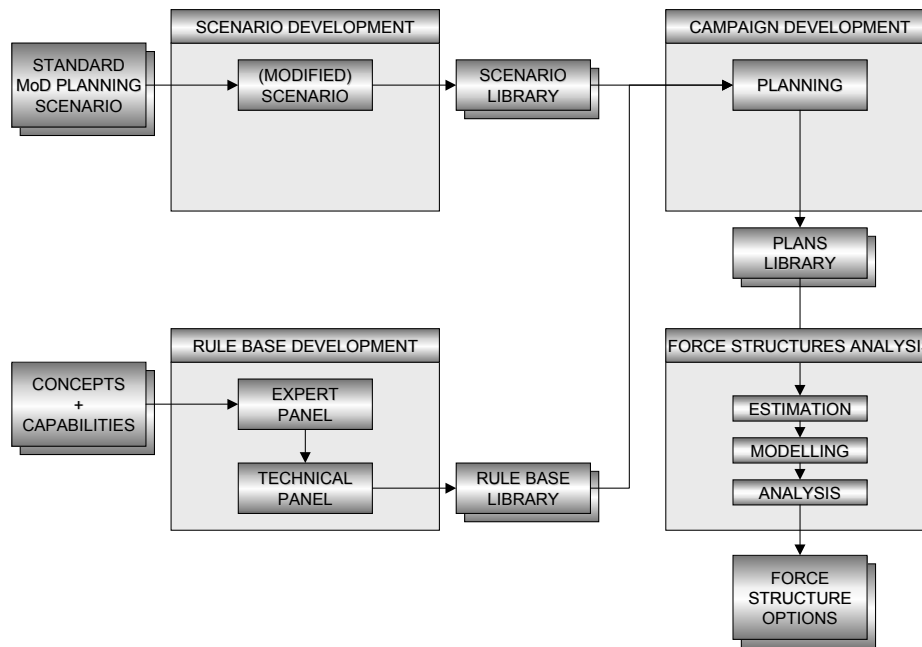
[1] Force Package Options – Figure 1

Figure 3: Joint Force Structure Development process

SCENARIO DEVELOPMENT

This part of the process redefines the UK MoD planning scenarios. These form a standard used throughout Dstl and MoD analysis – but they also have a prescriptive aspect to them – that is, certain assumptions on key events, their timings and their triggers. Anything that could be considered prescriptive in nature that might dictate or influence the approach taken has to be removed. This means that concepts that might influence these fundamental aspects of the scenario, such as effects-based planning, can be tested fully.

Though a relatively simple part of the Joint Force Structures Development analysis process, stripping out the scenarios to their most basic form is essential to the unconstrained approach to the analysis.

RULE BASE DEVELOPMENT

The basic rule base approach is retained, and remains key to the whole process. Whatever the concept, for force structure analysis purposes it must be represented within the pool of available force elements ultimately and that means determining detailed and specific assumptions, dimensions and so on. This is achieved through the rule base.

Method

The first stage of the process is to identify suitable force development concepts. Some concepts are carried over from initial Joint Force Structures Development analysis such as reduced deployed footprint, force projection, swarming Unmanned Aerial Vehicles (UAV), networked precision weapons; others are from ongoing work, such as asset tracking and space-based ISR assets. Further concepts can always be added -

the Joint Force Structure Development programme has its own pan-MoD management group responsible for programme direction and content. Concepts are thus generated from across the full MoD spectrum of interests.

A judgement panel is convened attended by a wide and representative range of scientific and military experts, though not exclusively in the field associated with the new concepts. This is because what is sought from this panel is novel and imaginative ways and understanding of how any such novel concept could be employed or exploited and what implications may arise.

The panel reviews each concept in turn to define its key characteristics and assess its maturity for advancing within the process. The characteristics include origin or background, key assumptions, implementation, advantages, risks and force package and force management implications. The expert panel thus provides the first filter of the concepts with the ones that have sufficient substance taken forward to a second level of review by technical experts.

The objective of the technical panel, which does comprise scientific and technical experts in the relevant fields, is to establish the technical feasibility, requirements and risks of the concept. From this guidance the Dstl analysis team distils the concept rule base which can then be used to guide the development of scenario force packages through the subsequent Force Estimation process performed by a military panel.

Though not influencing the military panel judgements, the related cost analysis can then be done to establish the likely cost of provisioning any new or modified force elements within the pool of deployable forces. These costs will be used in the subsequent force structures analysis as both a constraint and a measure of effectiveness.

Defining the concepts

Throughout the rule base development stage, concepts undergo constant refinement and definition. The scope, or extremes, of concept implementation must be defined also. It may be that the concept, realistically, does little more than replace a current capability and this may have little or no effect on the force structure. Equally, if was supposed that the concept could not only replace an existing capability but had broader utility as well then this may have more profound implications.

The concept definition work attempts to establish both extremes but importantly it always seeks to push the concept as much as possible. This is because by exploiting the concept as much as possible, novel approaches may be derived and this is very much in the spirit of the original tasking. More pragmatically, if a concept applied *in extremis* does not influence force structures, it gives greater confidence that it is not important to force structures per se.

That said, it has to be technically and militarily feasible and therefore military judgement is used in particular to assess when a concept may become no longer credible. It may be that the concept promises great gains, in flexibility, agility, utility and so on, but the secondary effects and managerial issues must not be overlooked.

As the rule base develops, the outline concept is defined further. For example, say the concept may be based on the exploitation of swarming - defined as the collection of autonomous individuals relying on local sensing and reactive behaviours interacting such that a global behaviour emerges from the interactions.

As this statement stands, it is simply too generic and ambiguous to apply and test within force structure analysis. A specific example is needed to continue the analysis. In this case the application of this in enhancing ISTAR product may be worth experimenting with. So a case for swarming UAVs is constructed. This forms the second level of the concept definition.

The technical and cost considerations and deliberations of the technical panel come into play now. The UAVs themselves have to be described too - their size, performance and capability, vulnerability and costs to name just some aspects. Others may include legal or other such interoperability implications and so on.

Costing the new concepts can be difficult with great uncertainty from a number of aspects – technical specifications, component costs, and production runs for example. Cost assumptions are derived, however, as much as possible from models and previous work from other, comparable systems or technologies.

We then need to incorporate the concept into the pool of available force elements. Does the concept require an entirely new unit type, or can extant units re-role or even be dual equipped? What equipment and personnel numbers are there? What does it cost and, very importantly, what can it substitute for in the force packages and what can substitute for it? More definition is needed and this requires a further and final level of refinement of the rule base that is completed with endorsement from military staffs. This aspect of the process is shown in Figure 4.

Figure 4: Concept definition stages
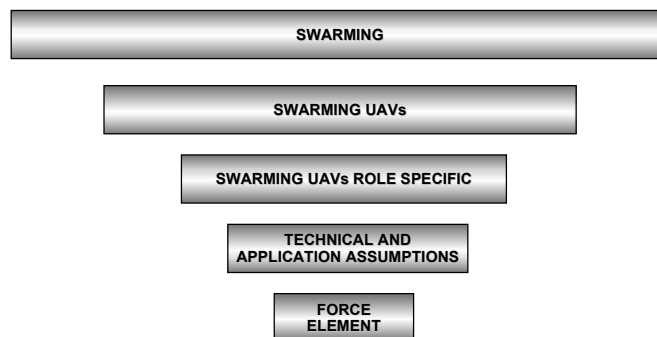
This gives us a start point with which to begin the analysis – almost any point will do as long as it is technically and militarily feasible.

CAMPAIGN DEVELOPMENT

The third stage, generating alternative campaign plans, is arguably, the most demanding of the whole process. The basic concepts, ideas and approaches, need to be translated into credible, coherent and achievable campaign plans.

The rules for this are simple though: whatever the approach taken it must be distinct from the current one; there are no constraints on force pool size or composition with the exception of levels of technology maturity and overall costs. Planning assumptions on scale of effort, for example, must be applied and can then be subject to subsequent analysis. In essence then, this stage needs to first *identify,* and then *evaluate,* alternative campaign options.

This work begins with knowledge of which scenario types are most likely to influence the force structure's size and composition. Those influences that drive the current force structure are well understood, though it is accepted that their influence on the current and anticipated structures is partly a reflection of the current approach used, that is itself a reflection of original force structure constraints.

The process considers options that are most likely to affect these drivers. Other options can be considered but are, in practice, unlikely to have as significant an effect on future force structures. This is because those drivers that remain extant may simply recreate the requirement for force elements that the current force structure addresses.

A more conceptual campaign development process for each of these scenarios can then be undertaken. Although loosely based on existing campaign development work[2], this activity seeks to develop a broad range of campaign options embracing new concepts. A game tree is constructed for decisions down the chain of command. Retaining the original strategic directive, alternative approaches for the Joint Task Force Commander are developed followed by more detailed component level planning. For each approach, an illustrative concept of operations, order of battle and capability requirements is produced. In principle, the game tree could be cascaded to lower tactical levels although this is unlikely to be necessary. An example of part of a game tree is given in Figure 5.

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                                        ┌──────────────────┐
                                        │      HEAVY       │
                                 ┌──────┤    EXTENDED      │
                                 │      │   BOMBARDMENT    │
                   ┌────────────┐│      └──────────────────┘
                   │SWIFT/DECISIVE│
                   └────────────┘│      ┌──────────────────┐
                 ╱               │      │   MEDIUM/LIGHT   │
                ╱                └──────┤      LAND        │
 ┌────────────┐╱                        │   DEPLOYMENT     │
 │ STRATEGIC  │                         └──────────────────┘
 │ DIRECTIVE  │
 └────────────┘╲                        ┌──────────────────┐
                ╲                 ┌──────┤GRADUAL ESCALTION │
                 ╲               ╱│      │ IN AIR ATTACK OF │
                  ┌────────────┐ │       │ STRATEGIC TARGETS│
                  │ PROGRESSIVE│─┤       └──────────────────┘
                  │  COERCION  │ │
                  └────────────┘ │       ┌──────────────────┐
                                 └──────┤BUILD UP(THE USE OF)│
                                         │      HEAVY       │
                                         │  GROUND FORCES   │
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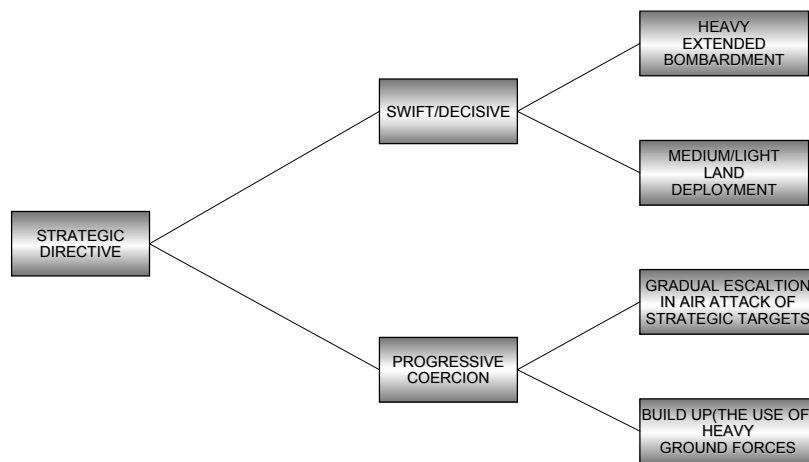
Figure 5: Illustrative Game Tree

It is important to note that although many options may be considered, it is the integral link with capability development which influences the feasibility of each option.

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[2] Campaign Options – Figure 1

The work allows us to draw on a wide range of planning teams comprising military, academics and analysts. This quick and light run through the standard campaign development process may be ideal for drawing out the real issues but analytically there is risk maintaining the right balance between innovation and credibility, and the depth of understanding may be limited.

The second stage of the work could use a form of game theory to relate and score the concepts by two means:

- If the game tree becomes complex, it may be solved using alpha-beta search routines which furthers an understanding of the relative risks and pay-offs between the branches.

- A second, perhaps more conventional method would be used to assess the matrix of belligerents' campaign plans. Harmonisation of plans for each element in the matrix would be through tightly controlled closed chronological games. Outcomes of a limited number of games could be validated using existing detailed models. This option offers the greatest breath of analysis and is capable of encapsulating some of the network-enabled benefits hitherto ignored.

In practice, a combination of these approaches will be appropriate – starting with a quick and low-risk, high level approach and, as the process develops and matures, increasing its depth and complexity. This stage of work produces a range of options for force packages (as before) to be tested against policy, but there would be no benchmark or base case option.

FORCE STRUCTURES ANALYSIS

In developing the campaign plans, the basic composition and balance of the force package assigned to it will be determined, though this then needs to be refined. Full consideration has to be given to representation of combat, combat support and combat service support forces, with a truly joint perspective.

This is achieved through the use of a modified Force Estimation process similar to the Force Planning Analysis one[3]. This will produce a balanced force package, considered the minimum required to undertake the campaign successfully within the time scale and casualty limits set, and is known as the 'sufficient' force package. It may not be as comprehensive as a real Order of Battle would be and may lack a degree of overmatch for example, but this is an important aspect to developing robust, well-balanced force structures suited to the great diversity of potential military tasks. By determining the absolute minimum required for each campaign in turn the structure is more likely to be able to provision forces to meet *any* of the various deployments: if each force package had excess capability, this could create redundancy and thus imbalance in the structure.

With the various scenario force packages agreed the concurrency modelling and analysis can be done and results produced. The model is set such that if the concept is

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[3] Force Package Options - Figure 1

attractive, in terms of utility, it will be selected; and quite simply, the more useful it is the more it will be selected for use. Conversely, if the capability of the concept is not needed, it won't be selected. This is important for our analysis; the implication is that even if a concept is highly capable it still may not be suited to the demand profile and not preferred over other options.

This base case application of the rule base then forms a start point for the analysis and can then be subject to sensitivity analysis - with four principal dimensions being explored. This is illustrated in Figure 6:
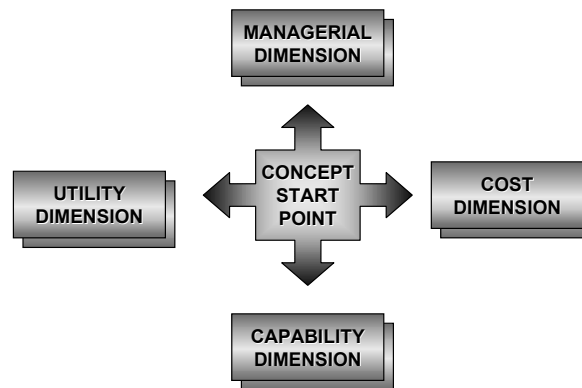

Figure 6: Sensitivity analysis dimensions

The dimensions encompass the salient assumptions made during the creation of the rule base; what can it do, how well can it do it, what does it cost and what would it mean for the force structure to include such a concept.

For example, what if the concept is not able to substitute for other force elements, is it still as popular? Then what about utility; what if a concept allowed a reduced deployed footprint - this might enable rapid effect, allow use on a greater range of scenarios, reduce personnel at risk and so on resulting in trade off with more capable but less agile force elements. In some scenarios this may be appropriate but in others the footprint may not be reducible – is the concept still as influential in the force then – and if not, what was it about it that caused it to be selected in the first place?

Through this process, rebalanced force structure options that reflect each concept are produced. Different concepts can be compared to reveal the changing exposure to risk each brings with respect to each other and to the current or planned force structure. Analysis can be conducted with combinations of different concepts to allow a more robust comparison.

SUMMARY

Current force structures have proved immensely stable. They are robust to a wide variety of threats and deployment types. Novel concepts tested so far have had very little actual impact on the force structure. This is because of limitations with the analysis process used to date, but also perhaps because of the complex inter-relationship of the many element types, the fabric of the force structure, that may mean you cannot change one aspect alone, it requires a significant shift in force balance – even though wholesale change may be costly, risky and not entirely practical.

Some of the fundamental limitations of the initial Joint Force Structures Development process have now been addressed: the process proposed here starts at first principles, with very few constraints imposed on which approach is taken or what is used to do it. It remains largely subjective throughout, but this is countered by comprehensive sensitivity analysis. If there really are step-changes in force effectiveness that can be realised though novel approaches or use of future technology, this process should now identify them.

ABOUT THE UK DEFENCE SCIENCE AND TECHNOLOGY LABORATORY

The Defence Science and Technology Laboratory is an agency of the UK MoD. It is the largest scientific laboratory in the UK with 3,200 staff based at numerous sites around the country.

Work carried out by the organisation includes analysis and systems engineering, technology solutions, and critical defence science. This work supports major defence decisions, defines requirements in terms of threats, options and risks, finds systems solutions, supports acquisitions, operations and looks at critical defence technology.

There are 1,200 staff working in the systems area, of which about a quarter are in the Policy and Capability Studies department, based in Farnborough. This department is tasked with helping the MoD make the best policy, procurement and operational decisions.

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FUTURE FORCE DEVELOPMENT CONCEPTS

Porter, Finbow, Pernin (RAND), Hadji

Defence Science and Technology Laboratory UK MoD

Presentation contents

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- Study method and process development

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- Summary

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Introduction

Presentation aim

- Demonstrate methods being developed by Dstl under the Joint Force Structures Development Programme which seeks to:

    – illustrate the impact information age concepts and technologies may have on future force structure design and effectiveness

    – in order to inform UK Force Development (transformation)

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MoD Force Planning Analysis

POLICY

OA

CONSTRAINTS

PLANNING SCENARIOS

CAMPAIGN OPTIONS

COSTS

FORCE PACKAGE OPTIONS

DYNAMIC CAMPAIGN ANALYSIS

FORCE PLANNING ASSUMPTIONS

CONCURRENCY

REQUIRED POOL OF FORCES

ILLUSTRATIVE FORCE STRUCTURES
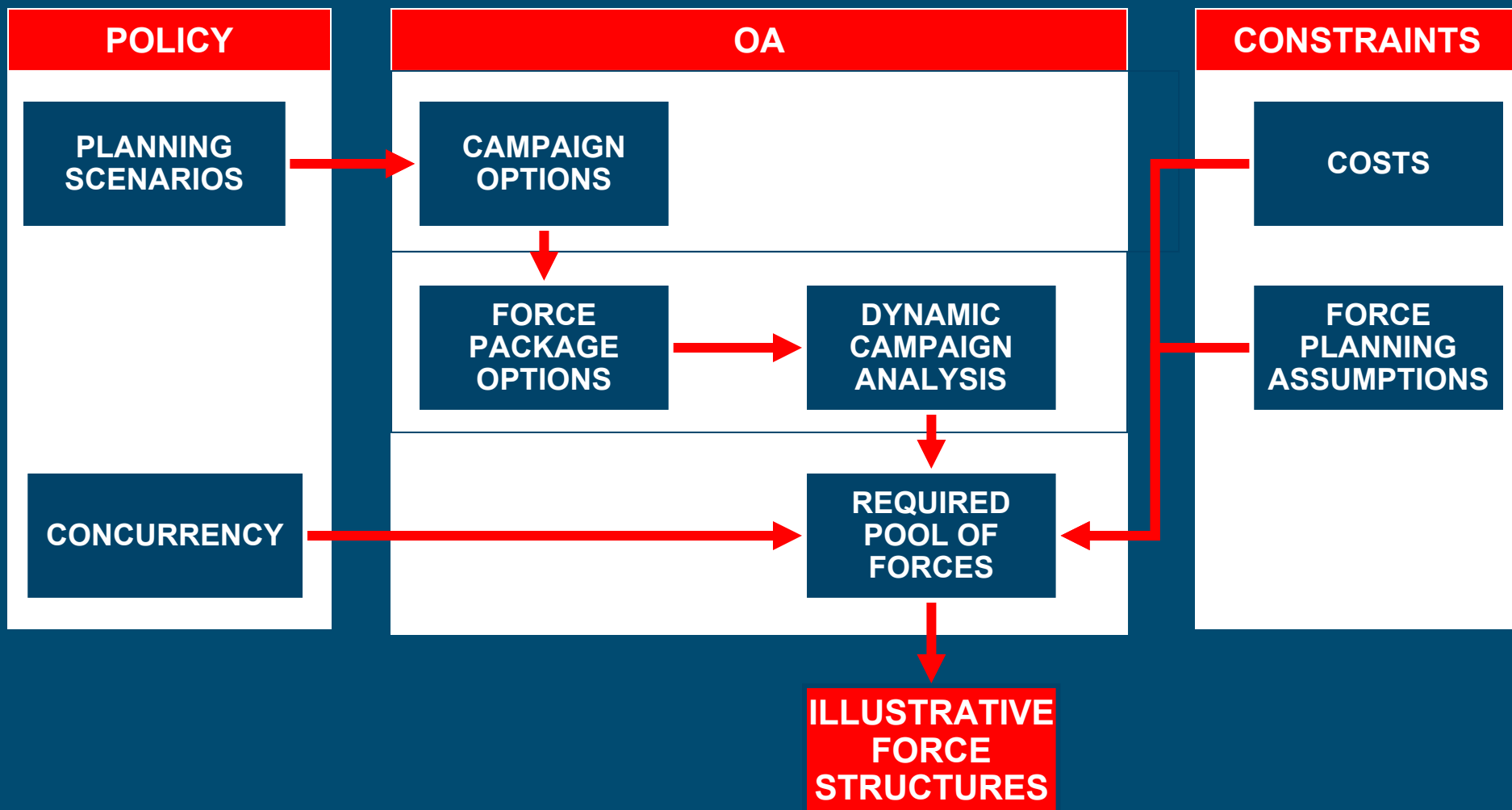
Role and Objective of analysis

- Joint Force Structures Development is a programme of analysis that:

  - assesses the more novel Force Development options

  - identifies the benefits and risks of alternative planning assumptions

  - considers structural implications for (UK) joint forces, focused on the period of 2020-2025

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Emerging results

Some force structure findings

- Initial results indicate that:

    – **Its not so much what you do, its how you do it**

    – **The translation of platforms into capability indicates how best to do it**

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Not *what* you do...

- A well balanced force structure is extremely robust to changes in Defence Policy

  - covering the spectrum of operations, threats, geographic regions and strategic developments

- Partly because many force elements have a high degree of flexibly or utility

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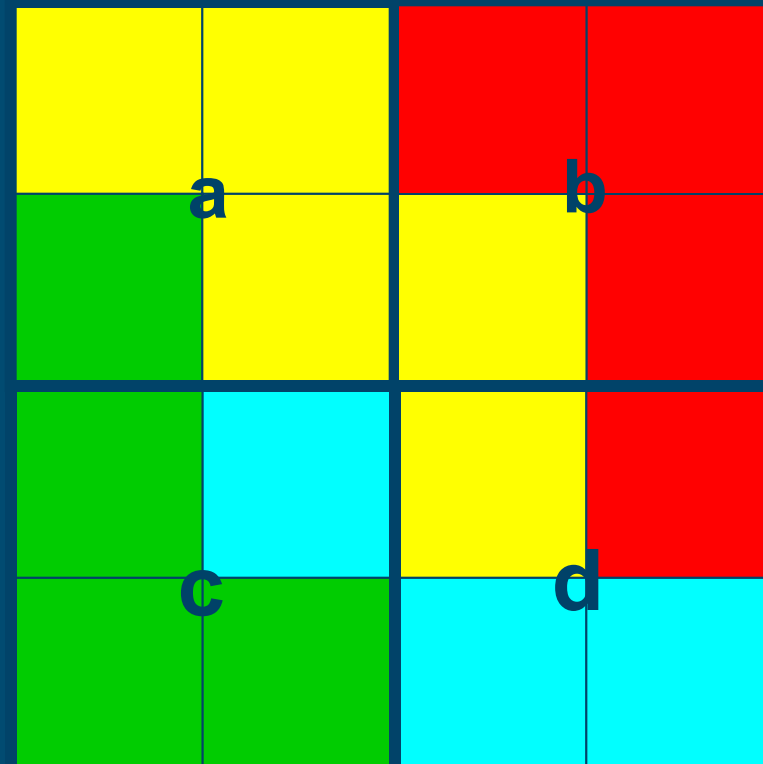Dstl is part of the
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...but *how* you do it

- Concepts, and the equipment capabilities which underpin them, are likely to generate the greatest change to the force package - and force structure

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However...

- New concepts and new technology which influence force package or structural change are hard to find

- How capability is generated from force elements favours certain concepts and hinders the creation of others

- High degree of flexibility within existing force structure creates interdependency of force elements - makes it resistant to change

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However...

Force Structure composition

a	**b**
c	**d**

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Yellow element

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Red element

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Blue element

Concept A

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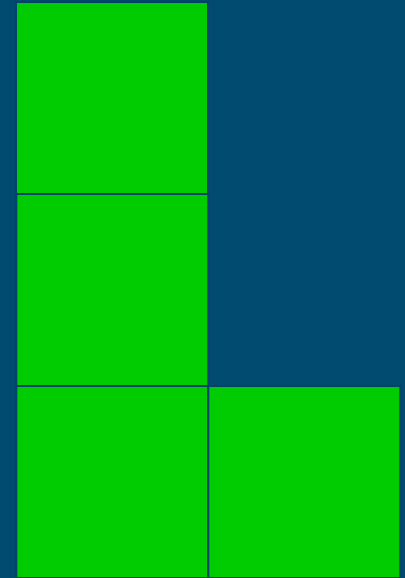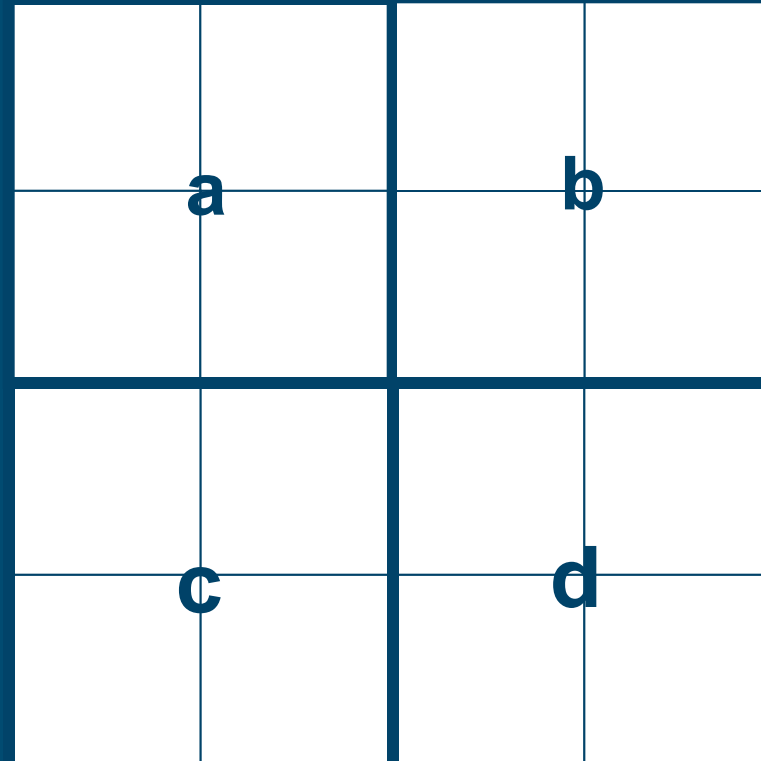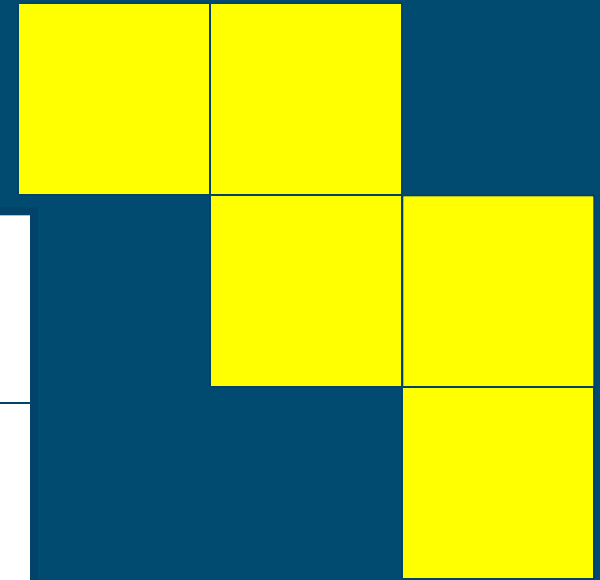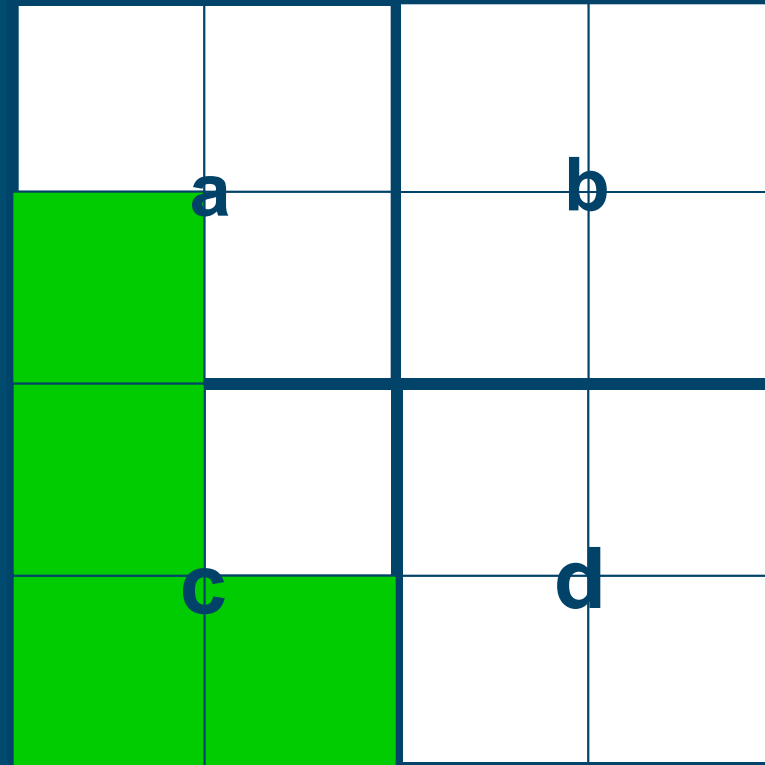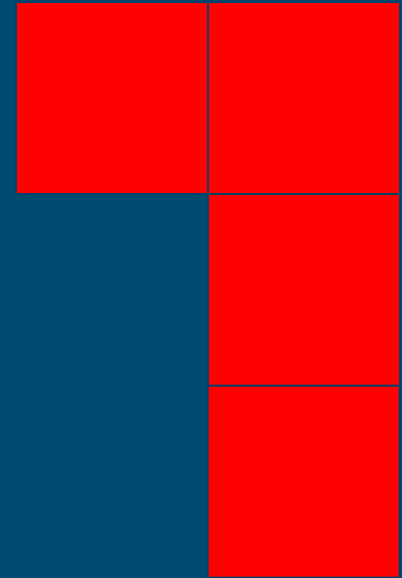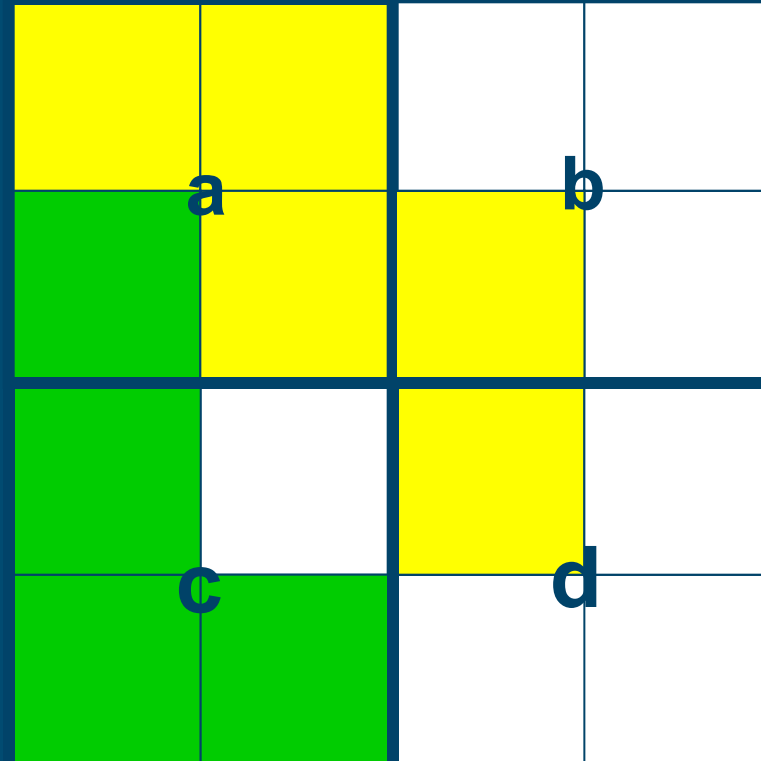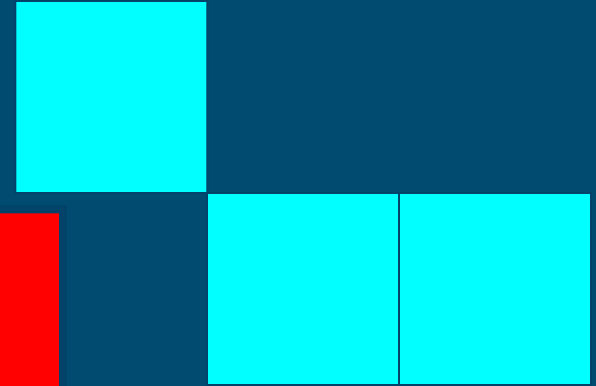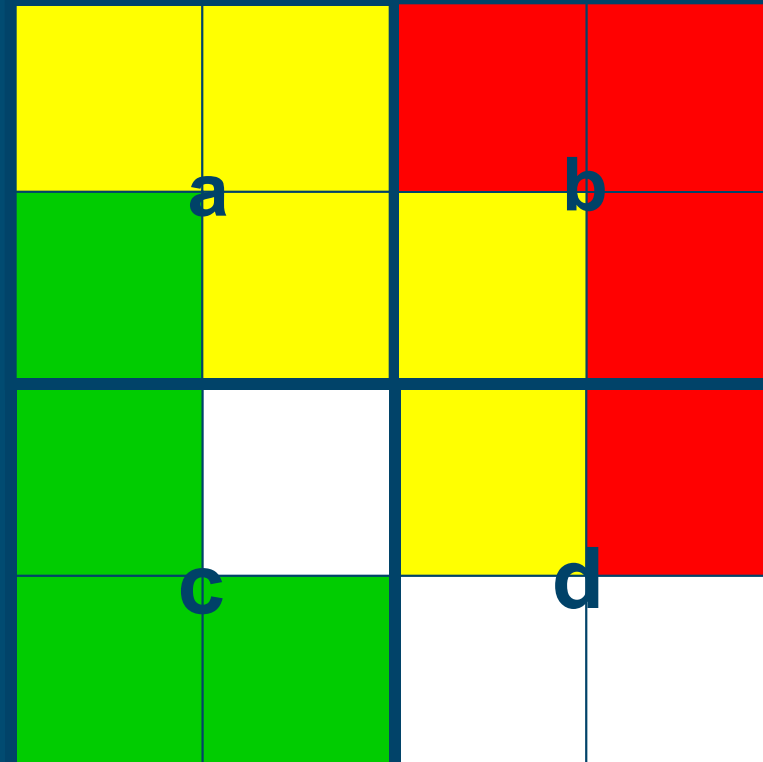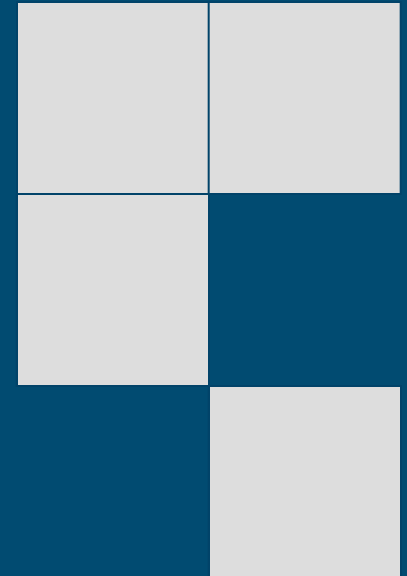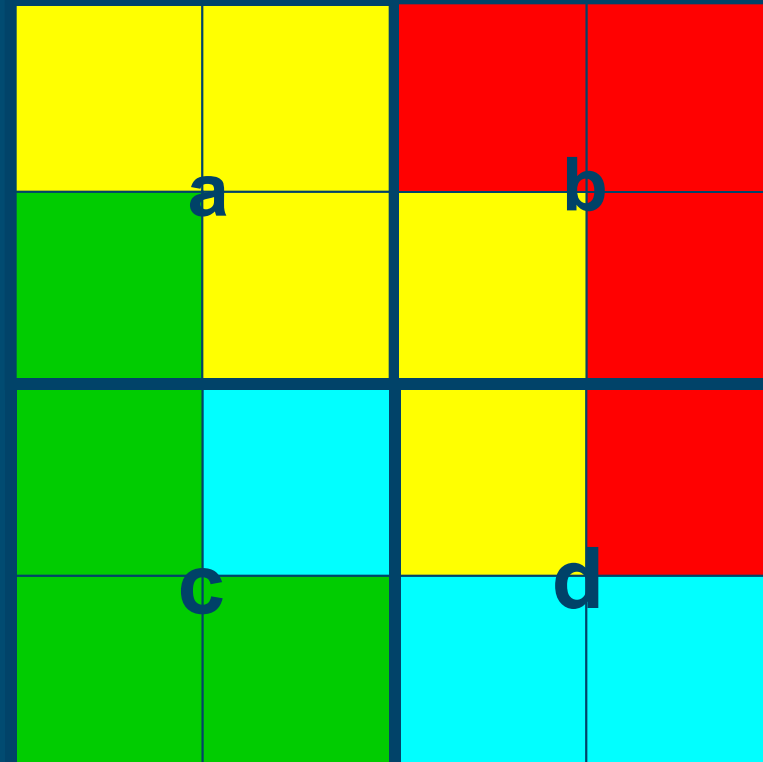
What happened to the concepts?

- One way of viewing the force structural implications of new concepts and capabilities are that they are either:

  – an improved way of doing something there already (e.g. new 'toy' - old method) or;

  – something offered beyond what is currently being done, and you have to do this to exploit it (new 'toy' *AND* new method)

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So what? Our conjecture:

- There *may* be a better force structure, but need to understand future equipment capabilities and concepts in detail to find it

- Likely to require significant force re-design and migration cost to new structure

- High levels of interdependency increase the cost barrier to translate to a radical new force

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Study method and process development

Four stage analysis method

- Scenario development

  – What sort of things will we have to do

- Campaign development

  – How are we going to do them

- Concepts development

  – What can we do them with

- Force Structures Analysis

  – What does this mean for our force structure

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SCENARIO DEVELOPMENT

CAMPAIGN DEVELOPMENT

RULE BASE DEVELOPMENT

FORCE STRUCTURES ANALYSIS

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Scenario development

- Planning scenarios provide the framework for force structure analysis

- Scenarios are developed to ensure there is a minimum level of implicit assumptions

- This essential to having unconstrained approach of analysis and avoiding prescriptive elements

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Concept development

- A rule base encapsulates the essence of any concept - the principles that reflect its unique characteristics

- Rule base is generated and refined using a series of advisory panels

- Rule base provides planning guidelines to campaign development

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Campaign development

- Two-stage conceptual campaign development process for each scenarios undertaken:

FIRST

  – a game tree constructed for decisions down the chain of command

  – alternative approaches are developed followed by more detailed component level planning

  – for each approach, illustrative concept of operations, force package and capability requirements are produced

  – multiple teams of military, academics and scientific staff

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Example game tree

```
                                                    ┌──────────────────────┐
                                                    │       HEAVY          │
                                   ┌───────────────▶│     EXTENDED         │
                                   │                │    BOMBARDMENT       │
                   ┌──────────────────┐             └──────────────────────┘
                   │  SWIFT/DECISIVE  │
                   └──────────────────┘             ┌──────────────────────┐
                                   │                │    MEDIUM/LIGHT      │
                                   └───────────────▶│       LAND           │
   ┌───────────┐                                    │    DEPLOYMENT        │
   │ DIRECTIVE │                                    └──────────────────────┘
   └───────────┘
                                                    ┌──────────────────────┐
                                   ┌───────────────▶│  GRADUAL ESCALTION   │
                                   │                │  IN AIR ATTACK OF    │
                   ┌────────────────────┐           │  STRATEGIC TARGETS   │
                   │   PROGRESSIVE      │           └──────────────────────┘
                   │    COERCION        │
                   └────────────────────┘           ┌──────────────────────┐
                                   └───────────────▶│  BUILD UP (AND USE)  │
                                                    │       HEAVY          │
                                                    │   GROUND FORCES      │
                                                    └──────────────────────┘
```

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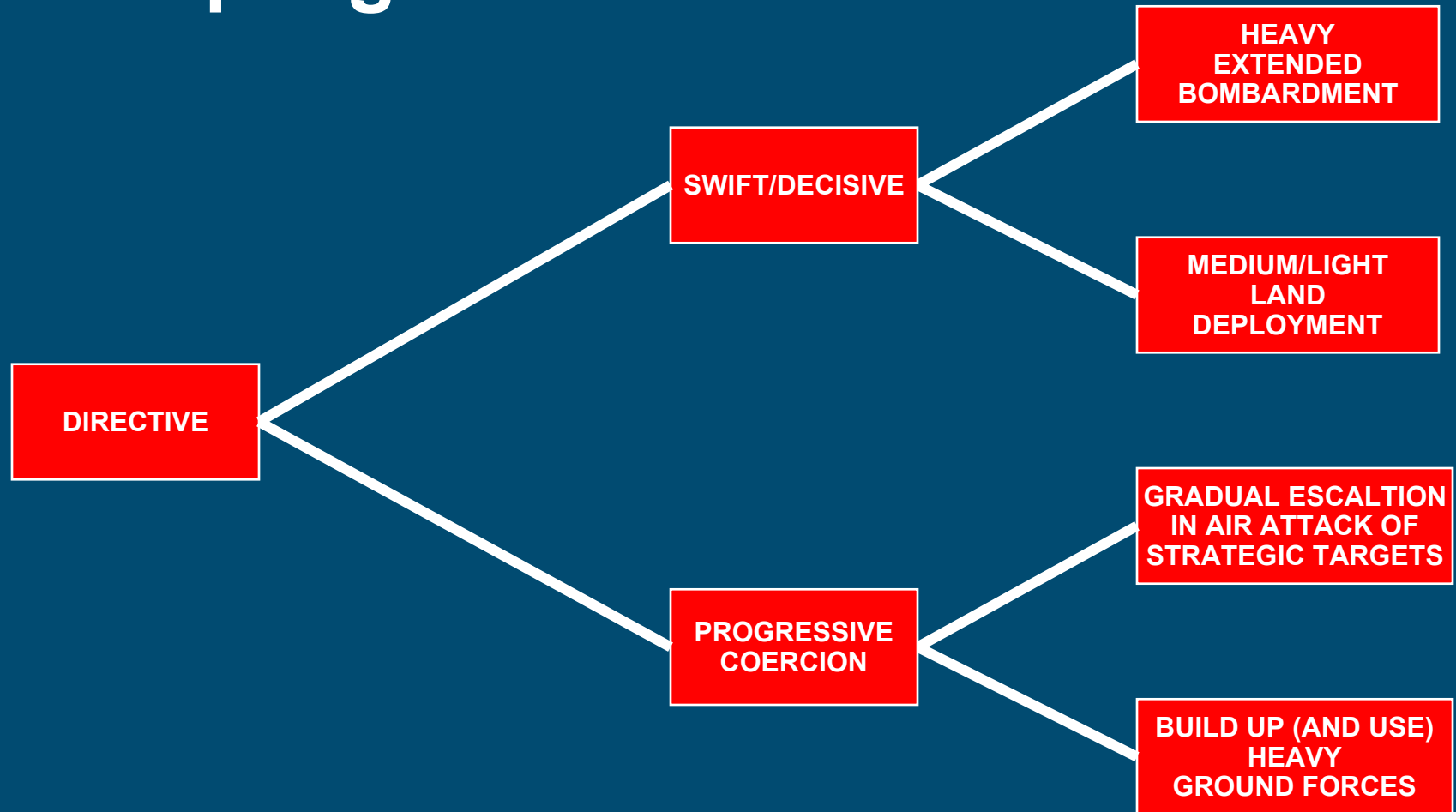
Campaign development...

THEN

– Each plan evaluated against a series of enemy plans through tightly controlled closed chronological games

  • advantages and disadvantages captured
  • Red/Blue combinations scored with suitable Measures of Effectiveness

– Game Theory used to test and evaluate relative risks and pay-offs between the branches

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Force structures development

- Force packages generated for all planning scenarios

- Policy-based demands and constraints are applied e.g.

    – concurrent deployments

    – force readiness requirements

    – harmony (frequency of deployment per individual)

- Ability of force structure to meet Policy tested

- Force then rebalanced to illustrate alternative structures of greater effectiveness - impact of concept assessed

SCENARIO DEVELOPMENT

CAMPAIGN DEVELOPMENT

STANDARD MoD PLANNING SCENARIO → **(MODIFIED) SCENARIO** → **SCENARIO LIBRARY** → **PLANNING**

PLANNING ↓ **PLANS LIBRARY**

RULE BASE DEVELOPMENT

FORCE STRUCTURES ANALYSIS

CONCEPTS + CAPABILITIES → **EXPERT PANEL**

TECHNICAL PANEL → **RULE BASE LIBRARY**

ESTIMATION

MODELLING

ANALYSIS

FORCE STRUCTURE OPTIONS

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Summary

Summary

- Planned force structures have proved immensely stable

  – concepts tested so far have had very little actual impact on the force structure overall

- This is because of

  – the complex inter-relationship of the many element types, the very fabric of the force structure

  – and the fact that it is not what you do, but how you do it that counts

- And this is what our programme is now focused upon with future campaign development work

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Questions?

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